

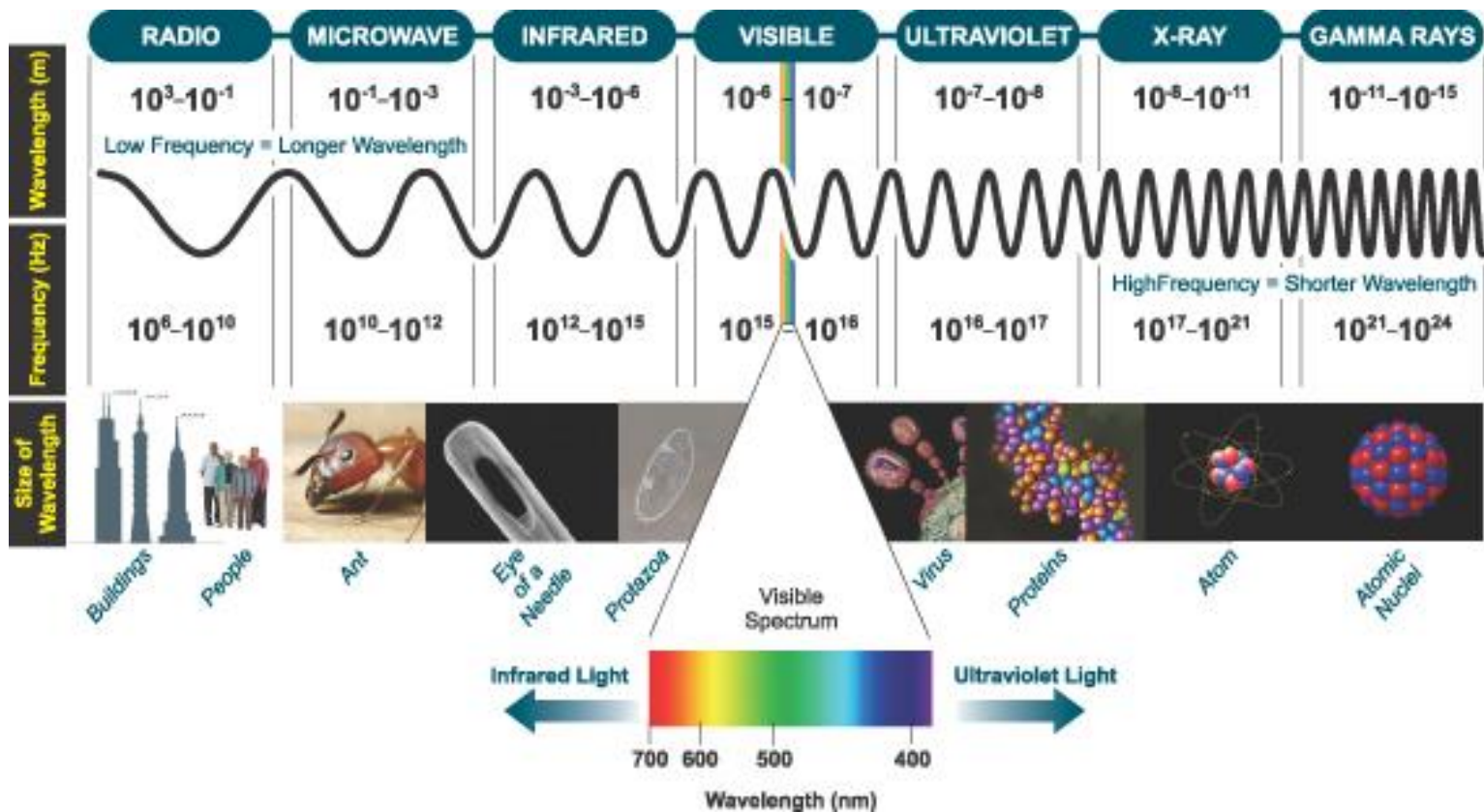
# ATOMIC THEORY, ISOTOPES AND RADIATION

Chapter 7.1 and 7.3



# ELECTROMAGNETIC RADIATION

- Energy transmitted in the form of electromagnetic waves sent out in all directions



# EXAMPLES OF ELECTROMAGNETIC RADIATION

- Ex. Infra-red, ultraviolet rays, radio waves, microwaves and X rays



Heat from Fire -  
Infrared



Sunburn - UV



Radio - Detect  
radio waves



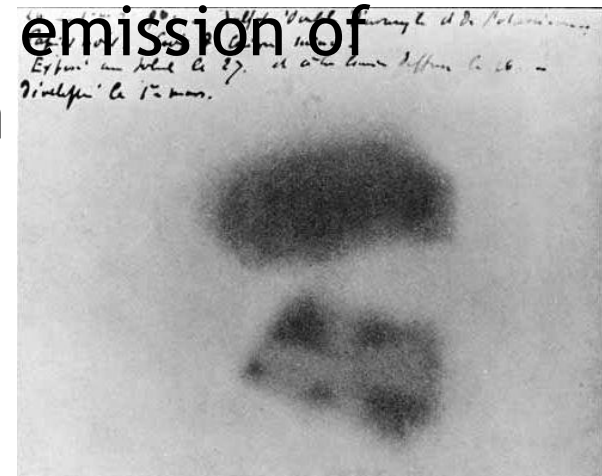
Microwaves



X-ray

# FYI: BRIEF HISTORY

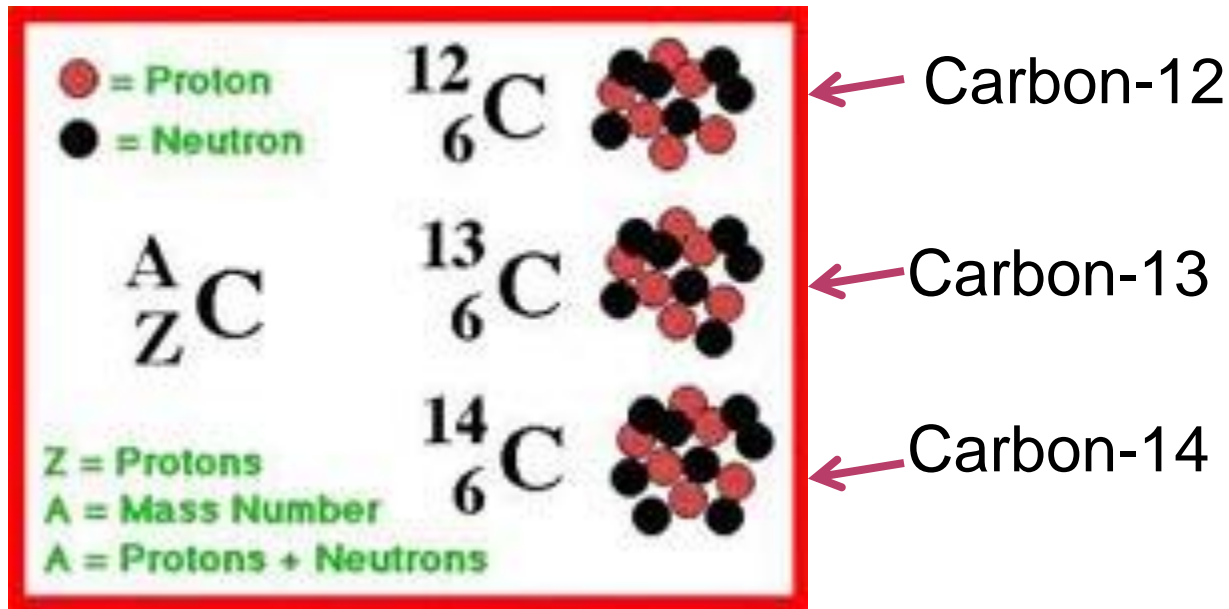
- Roentgen discovered X-rays which could penetrate paper and skin, but not bone and metal
- Becquerel discovered uranium was emitting a ray that was not an X-ray
- Marie and Pierre Curie coined the term **RADIOACTIVITY** as spontaneous emission of radiation from nucleus of atom





# ISOTOPES AND THE NUCLEUS

- ◉ The Nucleus of an atom contains Protons and Neutrons
- ◉ Mass number = protons + neutrons
- ◉ Isotopes are atoms of the same element that have the **same** number of protons but **different number of neutrons**

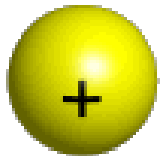


# ISOTOPES OF HYDROGEN

- ◉ The isotopes of hydrogen each have their own name

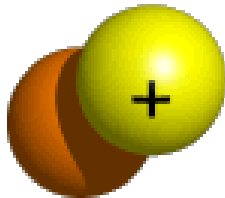
## The Nuclei of the Three Isotopes of Hydrogen

Protium



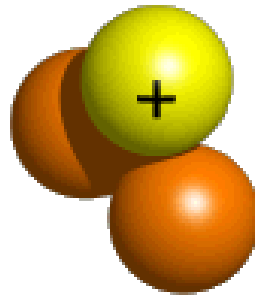
1 proton

Deuterium



1 proton  
1 neutron

Tritium



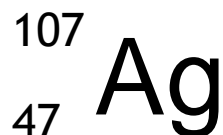
1 proton  
2 neutrons

- ◉ We write the symbols as follows



## SAMPLE PROBLEM

- Write the symbol for Silver-107. How many protons and neutrons does it have?



Since we know silver has 47 protons from the periodic table  $107 - 47 = 60$  neutrons

TRY ONE

Write the symbol for Beryllium-9. How many protons and neutrons does it have?

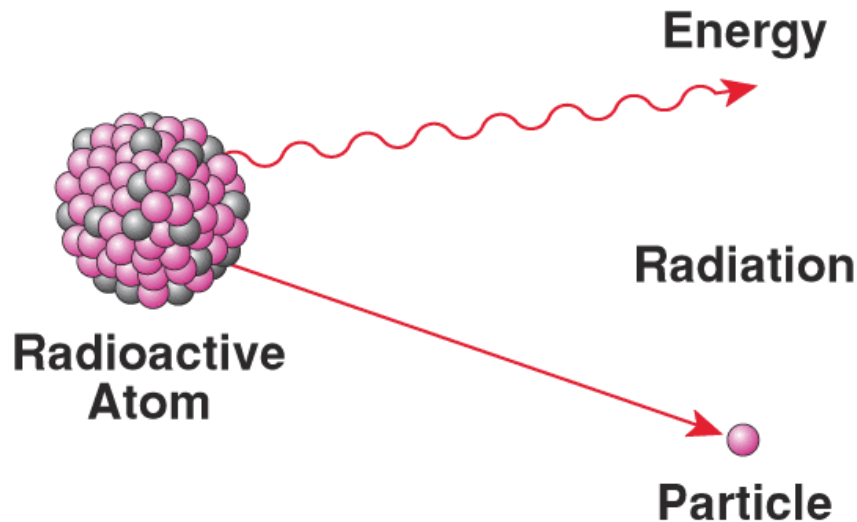
## REVIEW QUESTION

41. What isotope has 25 protons and 29 neutrons?
- A. copper-25
  - B. copper-54
  - C. manganese-29
  - D. manganese-54



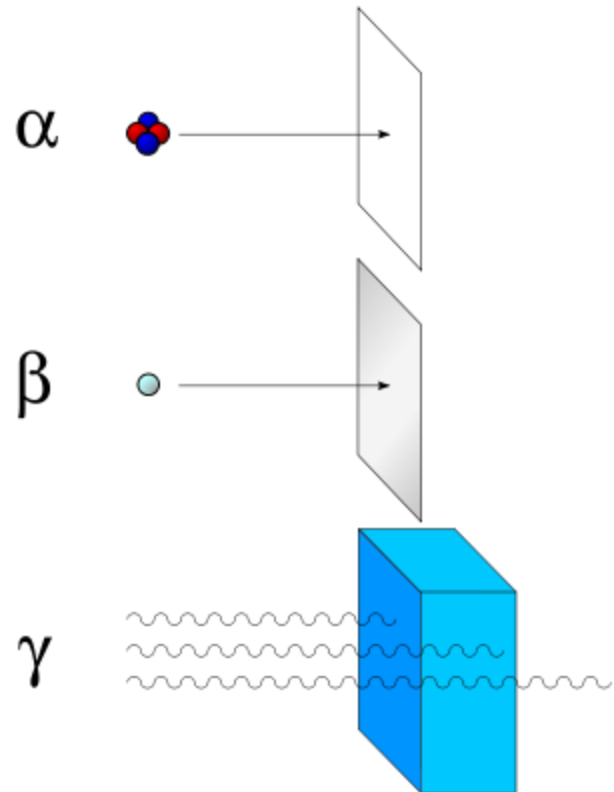
# RADIOACTIVE ISOTOPES

- Radioactive Atom - Atoms that **emit** radiation from their **nuclei**



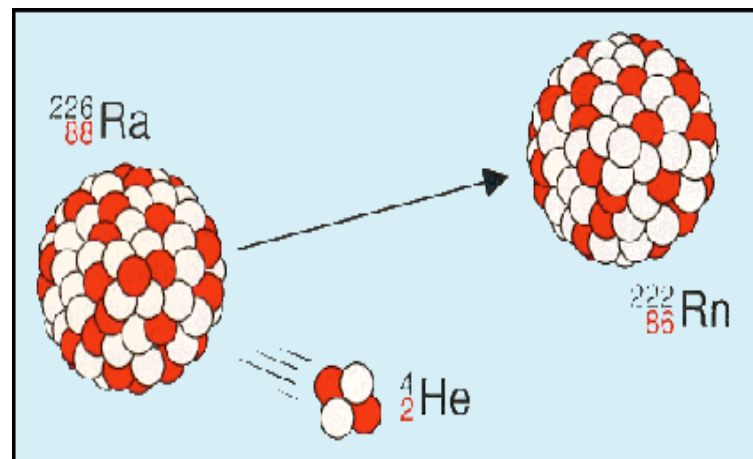
# RADIATION FROM RADIOACTIVE NUCLEI

- Naturally occurring radioactive nuclei can emit 3 types of radiation
  1. Alpha particle  $\alpha$
  2. Beta particle  $\beta$
  3. Gamma Rays  $\gamma$



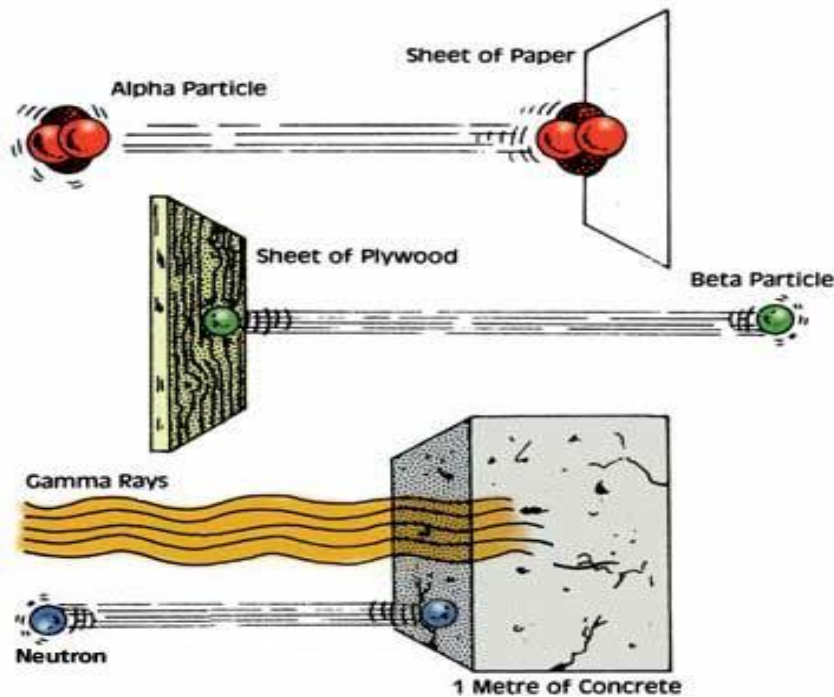
# ALPHA RADIATION

- ◉ Alpha radiation consist of **particles**
- ◉ Alpha particles are **helium nuclei**  ${}^4_2\text{He}$
- ◉ Composed of 2 **protons** and 2 **neutrons**
- ◉ They have a charge of **+2**
- ◉ The Symbol is  $\alpha$



# ALPHA PARTICLES

- ◉ Slow moving
- ◉ Can penetrate thin sheet of paper or human skin can absorb particles

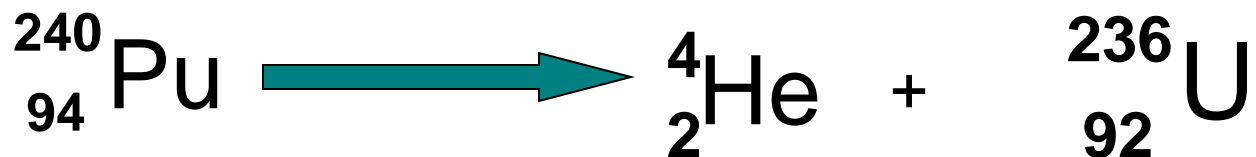


# NUCLEAR DECAY

- A nuclear equation is balanced when the sums of the atomic numbers and mass numbers is **equal** on both sides of the equation.

Ex. Alpha Decay

Parent Nuclide



Alpha Particle

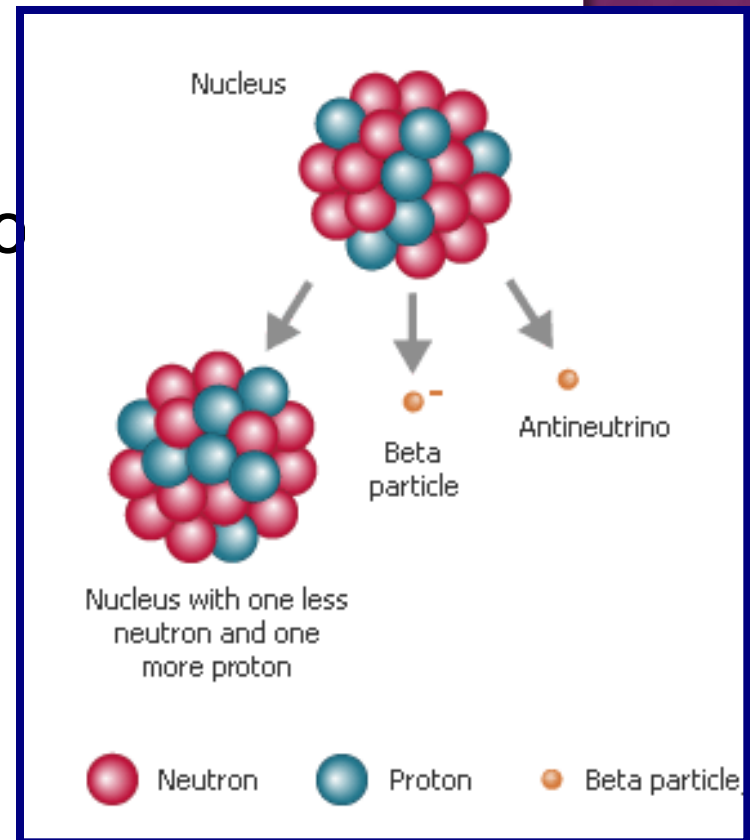
(Helium Nucleus)

$$\text{Atomic \#} \quad 94 = 2 + \underline{92}$$

$$\text{Mass \#} \quad 240 = 4 + \underline{236}$$

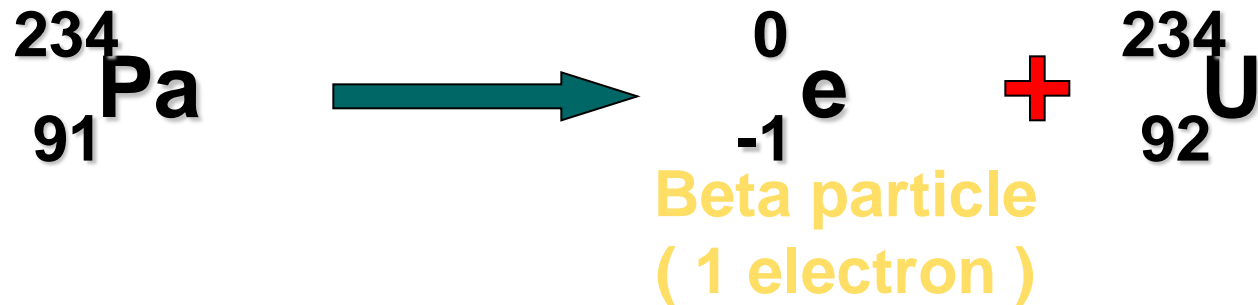
# BETA RADIATION

- ◉ Beta radiation consist of a particle
- ◉ **An Electron ( ${}^0_{-1}\text{e}$ )**
- ◉ They have a charge of -1
- ◉ Can penetrate a few sheets of aluminum foil





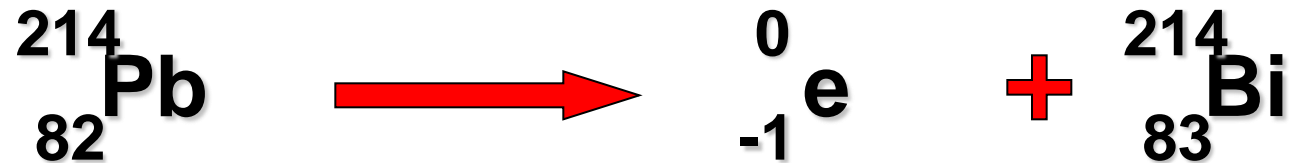
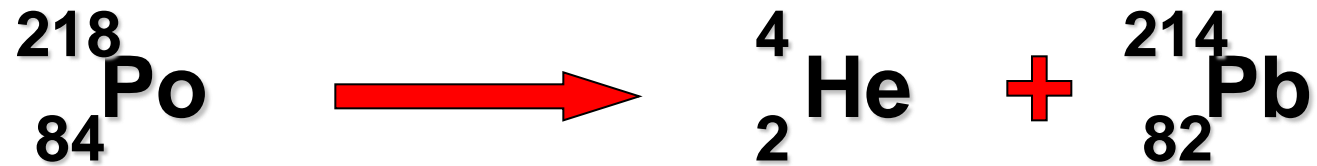
# BETA EMISSION



Atomic #     $91 = -1 + \underline{92}$

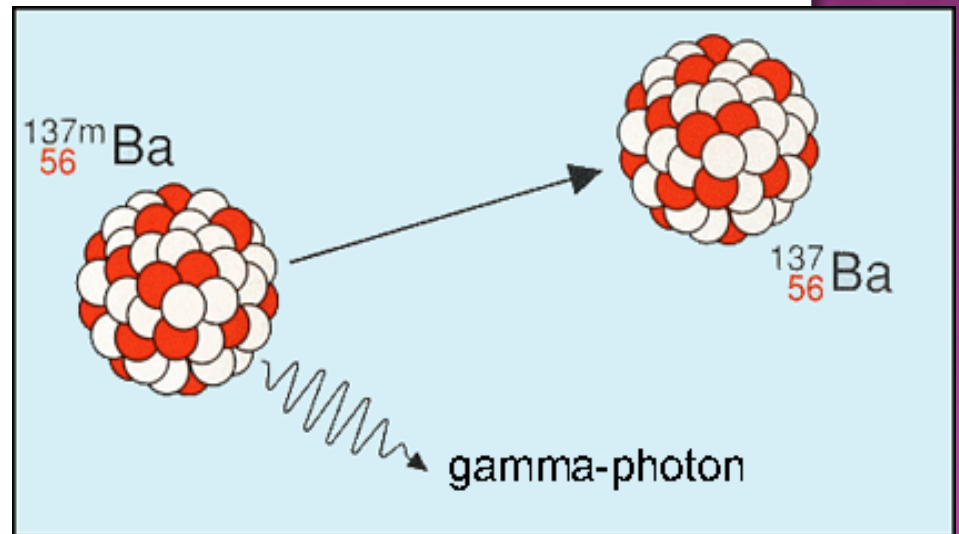
Mass #     $234 = 0 + \underline{234}$

- a) Alpha decay of  $^{218}_{84}\text{Po}$
- b) Beta decay of  $^{214}_{82}\text{Pb}$



# GAMMA RADIATION

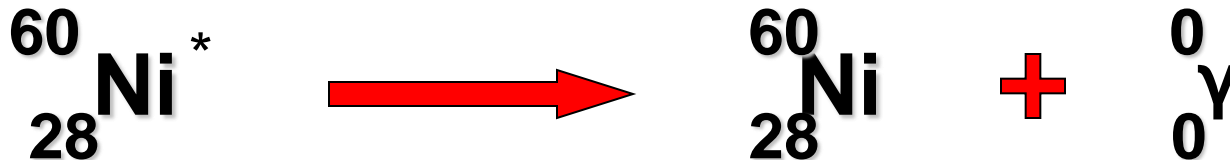
- ◉ **Not made of particles**
- ◉ Form of **electromagnetic radiation**
- ◉ Much more **penetrating** form of radiation than **alpha** and **beta**



# Gamma Decay

- ◉ Gamma decay results from a redistribution of energy in the nucleus.
- ◉ A gamma ray is given off as the isotope changes from a high energy state to a lower energy state

◉ Ex



- ◉ \* means the nickel nucleus has extra energy

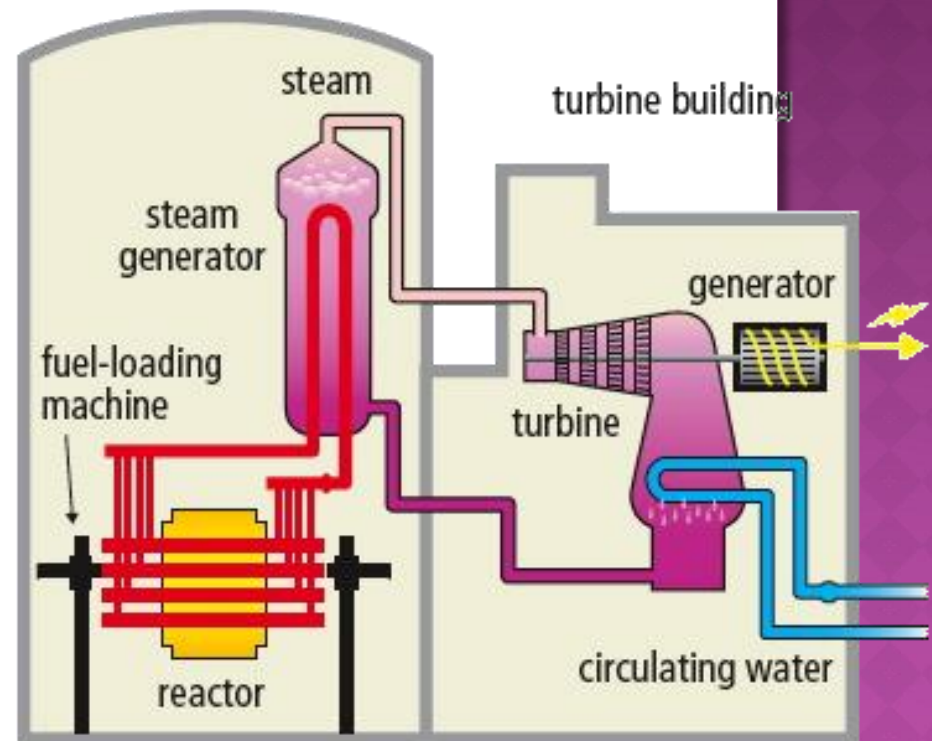
# FYI: GEIGER COUNTER

- ◉ A **device** that detects **radiation**
- ◉ Each time a radioactive particle **enters** the detector tube, an **electrical impulse** is sent to the **counter**
- ◉ This is recorded on the counter and creates a **clicking sound**



# NUCLEAR FISSION AND FUSION

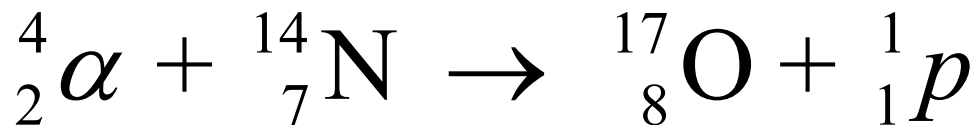
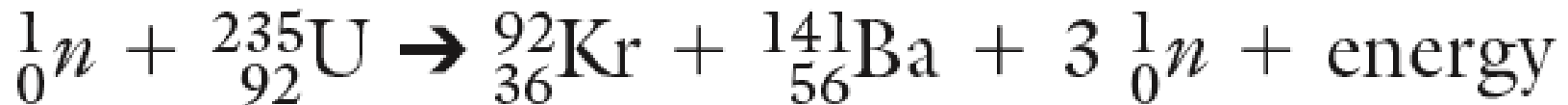
- ◉ Nuclear fission and fusion are processes that involve extremely large amounts of energy.



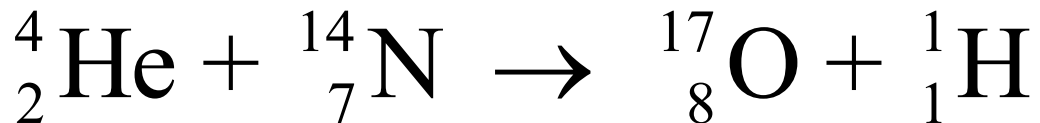


# FISSION REACTION

- ⊙ Fission = **splitting of nuclei**
- ⊙ Collide radioactive isotope with a particle or atom
- ⊙ Fission Demo



*or*



# NUCLEAR FUSION

⊙ Fusion = **joining of nuclei**

